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RESEARCH IN THE ADMINISTRATION OF FEDERAL REFUGES 1/

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To understand the objectives, the policies, and the methods employed in the administration of Federal migratory-waterfowl refuges as well as to appreciate the significance of the research work being carried on to facilitate such administration, one must consider the basic legislation that provided for the establishment and maintenance of these areas.

With the exception of legislation making provision for the establishment of particular refuges, as that which created the Upper Mississippi River Wildlife and Fish Refuge, the Bear River Migratory Bird Refuge, and certain others, as well as those set aside by Executive order, the legislation on which rests the Federal program of wild-fowl rehabilitation is embodied largely in two acts of Congress--the Migratory Bird Conservation Act of February 18, 1929, with its amendment of June 15, 1935, and the Migratory Bird Hunting Stamp Act of March 16, 1934, as amended June 15, 1935.

The Migratory Bird Conservation Act may be more fully described as an act "to more effectively meet the obligations of the United States under the migratory bird treaty with Great Britain by lessening the dangers threatening migratory game birds from drainage and other causes, by the acquisition of areas of land and of water to furnish in perpetuity reservations for the adequate protection of such areas, their maintenance and improvement, and for other purposes." In the text of the act is the following passage, "The Secretary of Agriculture (the Secretary of the Interior) shall recommend no area . . . under the terms of this act except such as he shall determine is necessary for the conservation of migratory game birds," and later it is stated that "for the purposes of this act, migratory birds are those defined as such by the treaty between the United States and Great Britain for the protection of migratory birds concluded August 16, 1916."

With respect to the other important law dealing with Federal bird refuges, the Migratory Bird Hunting Stamp Act, it should be noted that

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the act was passed to supplement and support the Migratory Bird Conservation Act and to administer "such areas, for the protection of certain migratory birds . . ." All moneys received under the provisions of this act are definitely allocated to the migratory bird conservation fund and are appropriated for specific purposes. Among other things, this fund is to be expended for the administration, maintenance, and development of refuges frequented by migratory game birds and for such investigations . . on such refuges and elsewhere in regard to migratory waterfowl as the Secretary (of the Interior) may deem essential for the highest utilization of the refuges and for the protection and the increase of these birds. It is further explained that the term "migratory waterfowl" used in this act refers to the species enumerated in the treaty concluded in 1916 between the United States and Great Britain for the protection of migratory birds.

Throughout the text of these two important pieces of legislation, as well as in that of other acts establishing refuges, is found the very definite concept that these refuges, although serving as havens and breeding places for various forms of wildlife, have been set aside primarily for the rehabilitation of migratory birds, particularly waterfowl. Their administration, likewise, is ordained by law for this rather specific purpose.

Regardless therefore of what may be thought ideal concerning the administration of refuges, their development as sanctuaries for wildlife generally, and their maintenance as wilderness areas largely free of human manipulation or interference, concepts worthy of the fullest encouragement, it will be seen that, in conformity with statutes, many of our refuges must be administered with the definite objective of increasing the number of migratory birds, particularly waterfowl. This is done largely through a process of restoring environment and giving to the birds protection and other advantages, some of which may be greater than those enjoyed under primeval conditions.

To facilitate this program of waterfowl rehabilitation and to assure soundness of procedure, the Biological Survey early inaugurated a research program so as to avoid some of the pitfalls of a trial-and-error approach to what was, in many of its details, an unexplored field. The reestablishment of extensive areas of marsh and water called not only for solving problems in land acquisition and for constructing suitable engineering structures with which to impound and control water, but also for instituting active campaigns of planting or transplanting vegetation to speed up the restoration of environment. The last-named objective proved to be a large field in which there was still much to be learned concerning the best methods of propagation and of storage of seeds and tubers, techniques of planting, and control of the excessive growth of plants that are of little use or are even detrimental in the general scheme of making things more attractive to waterfowl. Workers both in Washington and on several of the refuges focused attention on these practical aspects of wildlife research, and programs of action were soon instituted that tested the experimental findings. In the furtherance of this work the Civilian Conservation Corps rendered yoeman service, and the results are apparent in the rapid recovery of the vegetation on many areas.

Coincidently with the environmental restoration program arose the need of determining the effect on waterfowl of other animal life attracted to these newly established wildlife havens. Although waterfowl and marsh dwellers respond most quickly to the restoration of acquatic environment, other birds and mammals also take advantage of the improved conditions of both lowland and upland. That these restored areas might become focal points not only for waterfowl but also for their predators was recognized early in the refuge program. In order that action to remedy a situation might not precede thorough investigation, however, preparations were made to conduct necessary research on predator-prey relationships. This is a subject that is of more than ordinary interest and for that reason it has been chosen as the principal theme of this paper. In its management of refuges the Biological Survey endeavors to apply what it feels is a rational and reasonable procedure, and it desires to inform interested groups as to its objectives, its policy, and it methods.

To a large extent the investigations have been under the direct supervision of the Division of Wildlife Research of the Bureau of Biological Survey, with a few refuge managers in the Division of Wildlife Refuges, trained in research methods, supervising and carrying out similar work on individual refuges. A forerunner to the current program was the work done by Kalmbach and co-workers in Canada in 1934 and 1935, in the course of which an appraisal was made of the pressure exerted on nesting waterfowl by crows near the northern border of agriculture, an area in which the crow is exceedingly abundant. The results of that study clearly indicated that where a dense crow population exists in close proximity to nesting ducks, an appreciable egg loss may occur. Of 512 nests under observation, nearly 31 percent were destroyed by crows.

Despite the startling nature of these findings at points chosen to show the bird at its worst, the picture became appreciably less alarming when viewed in its continent-wide perspective. Crows are present in what may be termed destructive abundance on possibly a sixth of the duck-nesting area of Canada and Alaska. Beyond the limits of these overlapping ranges there is no serious crow-waterfowl problem in the north country. Within the borders of the United States it was evident that there were no considerable areas where the crow could be found in such destructive numbers during the breeding season, yet the conclusion was drawn that "where conditions similar to those encountered in the studies arise on important areas dedicated primarily to the welfare of nesting waterfowl, rational crow control should become an integral part of any game-management program."

To learn whether the crow was, in fact, a hazard to nesting birds on Federal refuges was the main reason for instituting a series of similar studies within the United States in the years immediately following the work in Canada. These researches, however, were soon enlarged to include observations on various other predators and on other suppressive factors that might curtail the annual production of waterfowl. Among the earliest of these studies was that carried on at the Lower Souris Refuge, an area in North Dakota adjoining the Canadian border. For 4 years one or more trained biologists have been engaged in the work, aided by the regular refuge personnel and members of the C. C. C. Some of the results have been recorded in the Transactions of the North American Wildlife Conferences.

At the Bear River Migratory Bird Refuge, in Utah, notable work on habitat preferences of waterfowl and on predator-prey relationships has been done by C. S. Williams, W. H. Marshall, A. H. Trowbridge, and others. Several papers on the results of their investigations have been published and their findings have been used directly in improving refuge management.

Trained biologists have conducted intensive nesting studies at the Valentine and Crescent Lake Migratory Waterfowl Refuges, in Nebraska. At the former, Ward M. Sharp, the refuge manager, with the help of C. C. C. personnel, has been carrying on such investigations since 1937, and at the same time has conducted plant-propagation experiments to aid in the rehabilitation program. At Crescent Lake, Ralph H. Imler, of the Denver Food Habits laboratory, found that bull snakes were preying excessively on waterfowl nests and made some worth-while suggestions for their control.

At Malheur Refuge in Oregon, Clarence A. Sooter, of the Food Habits staff, in a detailed 2-year study of nesting has discovered some important factors affecting the welfare of waterfowl on that area, and although more information is needed before definite policies concerning the control of predators and other adverse elements can be established, a sound foundation is being laid.

In less intensive fashion and on a more limited scale, studies of nesting waterfowl have also been made on several other refuges, all with the object of gaining information that will be of help in increasing waterfowl production as well as in avoiding mistakes in management that might result were action taken before thorough investigation.

A brief review of some of the findings may be of interest to those who, quite properly, are solicitous concerning the welfare of predaceous birds and mammals that might suffer from overzealous attempts to adjust the interrelationships of wild creatures. Among the data obtained, those relating to the crow, alleged archenemy of waterfowl, may be mentioned. In marked contrast to the heavy pressure exerted by the crow on nesting waterfowl along the northern border of agriculture in the Prairie Provinces of Canada, this bird has played a relatively inconspicuous part in depredations on waterfowl on Federal refuges where nesting studies have been conducted. On the Lower Souris Refuge nest destruction attributed to the crow averaged less than 5 percent during the 4-year period of the studies, and most of this destruction occurred in 1939 in a section of the refuge that was occupied by ducks for the first time and was close to a timbered area where crows were abundant. A comparison of the fate of duck nests in this heavily infested area with that in other parts of the refuge relatively free of crows has statistically indicated the pressure exerted. A few crows are present on the two Nebraska refuges (Crescent Lake and Valentine) where studies have been conducted, and they occur in sufficient numbers on Malheur Refuge to affect the nesting equation in a minor way, while at Bear River Refuge they are rare and play no detectable part in losses of waterfowl.

Other predators on birds' eggs that are found on western refuges are the raven and the magpie, both of which occur at Malheur and Bear River Refuges. The raven, in fact, is looked upon as the outstanding predator on nesting ducks at Malheur, and the magpie played a rather conspicuous role in egg destruction at Bear River in 1938, when 12 percent of the eggs in the nests studied were destroyed by these birds.

The first year's work on the Lower Souris Refuge revealed a degree of nest destruction (30.4 percent) by skunks that closely approximated the heavy losses inflicted by crows in Canada. Although the extent of predation by skunks on this refuge fluctuated, it averaged more than 13 percent during the 4 years the study was carried on. These animals also have been conspicuous predators on eggs at other refuges. At Valentine refuge 10 percent of the duck nests in 1938 were pilfered by skunks, and in the season just passed (1939), this loss rose to 14 percent. At Crescent Lake, in western Nebraska, skunks destroyed 6 percent of the nests in 1938 and nearly 13 percent in the following year. At Malheur Refuge skunks have so far played a minor part in egg destruction. During the first year (1937) of the studies at Bear River Refuge, these predators molested comparatively few waterfowl nests; in 1938 their activities became more conspicuous; and in 1939 skunks were the outstanding predators on the refuge, having destroyed 101 of the 563 nests under observation, nearly 18 percent.

The coyote, next to the crow probably the most publicized predator on game, has so far proved to be a factor of importance with respect to waterfowl only on Malheur Refuge, where it ranks next to the raven in its nest-destroying activities. Limited evidence of its inroads on the breeding grounds of waterfowl at other points has been discovered; but in areas where intensive studies have been conducted, the coyote has yet to prove itself a menance.

In sections where it is abundant, the bull snake is of more than ordinary importance as a factor affecting waterfowl reproduction. This is particularly true on some of the Nebraska areas, where excessive losses have been disclosed. During the past two seasons (1938 and 1939) these snakes destroyed 42 percent of the eggs in nests under study on Crescent Lake Refuge, and made that refuge one of the most hazardous areas for waterfowl under Federal supervision. Blue-winged teals and shovelers are particularly vulnerable to attack by bull snakes because of the small size of their eggs. Data from the work of the first year show that the severity of predation by bull snakes on the several species of waterfowl is nearly in inverse ratio to the size of the eggs. Valentine Refuge, in Nebraska, and Lacreek Refuge, in South Dakota, also have this problem, but in lesser intensity.

This recital of the main findings of the research program aimed to improve refuge administration should not give the impression that control of predation is looked upon everywhere as a paramount factor in the successful handling of the refuges. That it is an element not to be overlooked, however, has been fully demonstrated. To show the significance of predation and at the same time to determine whether control is desirable or is worth the effort in terms of increased yield, it may be explained

that control has been conducted on a number of the major refuges where nesting losses from predation seemed abnormal. In the winter of 1937-38 more than 400 skunks were removed from the Lower Souris Refuge. Later it was necessary to eliminate other individuals that had moved into the area during the following spring or early in summer and were making an easy living on the abundant food there, including the eggs of nesting ducks, as was convincingly shown by subsequent examination of the contents of their stomachs at the Bureau's Food Habits Laboratory at Denver. Nesting studies showed that losses often ceased when certain individual skunks were removed; at other times, grouping of nesting casualties gave unmistakable evidence of the presence of an undiscovered skunk den.

Somewhat similar results were noted from the removal of nesting crows from localities where the feeding radius of the adults included prime duck-nesting grounds. Beyond these limits no effort at crow control has been made. At Malheur Refuge ravens are removed when they are found to be obtaining most of their food in the immediate vicinity of duck nests, and at Bear River the magpies that use willows near the center of a choice waterfowl nesting area are kept within reasonable limits during the breeding season. At Crescent Lake notable progress has been made in devising methods for trapping bull snakes. Some idea of the abundance of these snakes on this refuge may be gained from the fact that more than 300 were removed in the course of experimental trapping and other control measures carried out, along with the nesting studies, during the summer of 1939.

Under primeval conditions wild fowl successfully withstood the drain put on them by predators, and even under most conditions today average predation need not be looked upon with alarm. When habitats were ample, populations large and scattered, drainage unheard of, and when the pressure of hunting by man was nonexistent, wild fowl had many advantages of which they now have been deprived. In the attempt to restore these, effort is made to give waterfowl under immediate care every possible aid, including advantages they may not have had under normal conditions in the wild. To speed up recovery, relief from conspicuous and demonstrated pressure factors is provided. The belief that this policy has a sound biological basis is strengthened by the realization that a refuge program is certain to concentrate wildlife, both prey and predator, with a resultant intensification of struggle between the two.

The fact should be emphasized that the whole program is still largely in the status of investigation and experiment and that action already taken still remains part of the research, in that the results are being closely watched and their values appraised. Naturally, a period of years is necessary to give reliable and adequate information, and any mistakes in theory or practice that subsequent work may disclose will assuredly be rectified and the experience gained will be used in improving refuge administration. The entire program is based on the sound biological principle that thorough study by competent investigators shall precede any needed adjustment of wildlife interrelationships. If the facts disclosed indicate only a minor disadvantage to waterfowl, letting nature take its course is the wisest and cheapest policy. Even where the findings reveal a condition in need of adjustment, the action program still retains elements of experiment and

investigation. Stomachs of all creatures removed in these campaigns are saved and examined to verify and round out data obtained from field studies. Furthermore, continued investigations by resident biologists on the several refuges will guide the program and provide information as to possible benefits accruing. Even now it is evident that the least it is found necessary to do to obtain optimum production of waterfowl will be the safest, sanest, and cheapest way to meet our obligations as defined by legislation.

To a very great extent wild creatures of all kinds live their normal lives on Federal waterfowl refuges, aided, or at least not hampered, by administration. It is the exceptional species, one with some habits objectionable under the circumstances, attracted by and increasing under the protection afforded, that is in need of local or temporary control. Over much of the federally administered refuge lands these creatures are living normal, unmolested lives and are playing their part in the general scheme of wildlife interrelationships. Outside the refuges, on farms and improved lands and on more or less wilderness areas, maintenance of a balanced supply of the creatures that must be controlled locally is steadfastly advocated. As fur animals, as predators, and as insect destroyers they have their valued functions.

The predators controlled locally also may benefit refuge administration through preying on rodents or other life that may be a hindrance or a hazard to the primary objective. It is conceivable that excessive populations of rodents may curtail the food supplies planted and reserved for game and seed-eating birds, that muskrat populations may increase to the point where damage to dikes is threatened, and that ground-insect infestations, which skunks may help in controlling, may reach objectionable proportions. Whenever such circumstances present themselves, the program of action will be shaped to meet the demonstrated biological facts, so that the ultimate results will accrue to the benefit of waterfowl.